AMSAT SATELLITE REPORT

Volume 1 Number 17
October 5, 1981

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Tech Brief: UoSAT Radiation Counters

In *ASR* #13, 10 Aug. 81, we introduced you to one of the experiments on UoSAT, namely the phase referenced HF beacon experiment. Here, in this second of *ASR's* Tech Briefs on UoSAT, we will briefly examine the radiation detectors experiment. We will look at the instruments and explain what they are, how they work and what may be learned from them when operated in space.

The central components of the radiation detector equipment are the two Geiger-Mueller tubes. To introduce the experiment, we will first look at how these devices work. Also called a Geiger counter, the devices on UoSAT are gas-filled, ionizing radiation detectors with a general scheme as portrayed in Figure 1. When operated in the proper Geiger region, the Geiger-Mueller tube produces an output pulse of approximately constant magnitude for each ionizing event occurring in the vicinity of the electrode.

The center wire of the tube is sufficiently small that a very high field gradient exists near it. When an electron of sufficiently high energy impacts in this high field region, it produces an avalanche effect in about 10 microseconds. However, the remaining positive ions remain as a sheath around the central region to destroy the voltage gradient because of their high mass and low mobility. The result is that the tube is unresponsive to further stimulation for a short period called "dead time." (See Figure 2.) The dead time lasts as long as it takes for the positive ion sheath to propagate out from the central region to a point where the field can recover (recombine) and another avalanche can occur. The resolving time is the time required for a second event to generate a pulse of sufficient amplitude to trigger the detector mechanism. The recovery time is the time required for a subsequent ionizing event to produce a pulse of the *original* magnitude. As shown in Figure 2, the recovery time is longer than the resolving time which, in turn, is longer than the dead time. The timing of these factors determines how quickly the tube can respond to events and thus sets the limit on the flux or number of counts. A typical Geiger-Mueller tube has a recovery time in the order of 100 to 200 microseconds. A tube using a halogen quenching gas such as those on UoSAT has a useful life of about 10^{10} counts. Special mica windows provide minimum thresholds of 20 keV* and 40 keV for the two tubes. The window's thickness varies. The thicker the window, the higher needs be the energy of the particle to penetrate it. The UoSAT Geiger-Mueller tubes also have collimators which act to screen particles from all but the preferred direction. Thus the instrument is sensitive to radiation from a very selective region only.

The data that accumulates in the UoSAT on-board data handling system will be the integrated electron flux at each of the two threshold levels, i.e., 20 and 40 keV. During solar flares, the sun radiates copious quantities of particles. These particles arrive in the vicinity of Earth's orbit in 24-48 hours depending on their energies. On the other hand, radiation such as x-rays and ultra-violet arrive in about 8 minutes. By watching UoSAT telemetry channels 03 and 04, one can watch the radiation count on UoSAT as it is being made (real-time measurement). Alternatively, if the data is stored on-board for readout later, the count can be dumped on command for readout from the ground of any particular previously logged interval. By using this stored data feature, UoSAT scientists can, for example, program the computer to store the measurements made while the spacecraft was over the South Pole and then to transmit the accumulated data to the ground on command. Thus, the spacecraft can act as a remote control probe making measurements while it is out of sight of the ground stations and then later dumping the results to that station.

*keV: kilo electron volt; a unit of energy

Reminder: Annual Meeting 17 October 1981 at Goddard Space Flight Center, Greenbelt, MD.

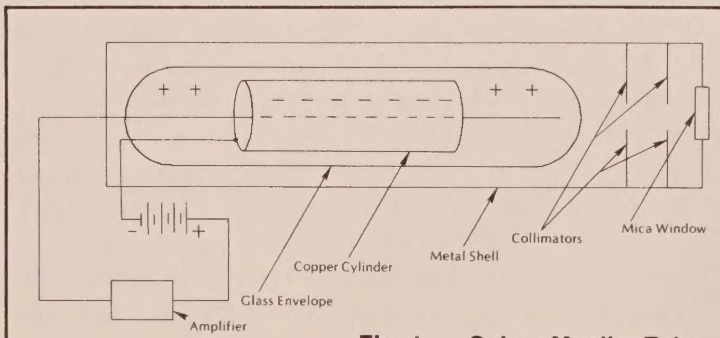
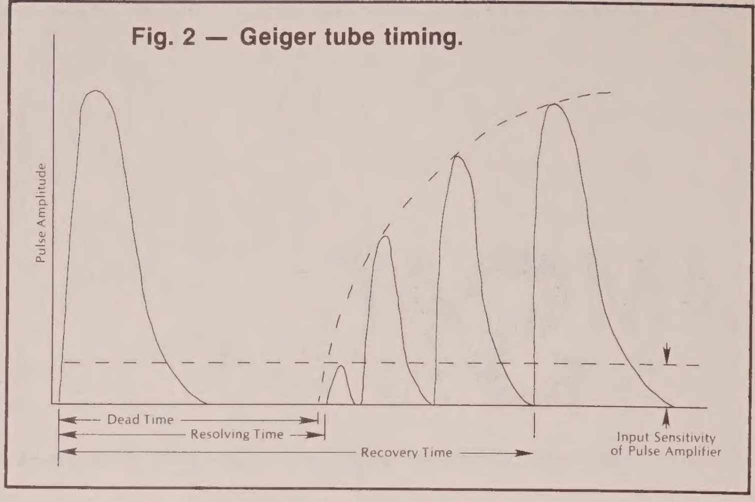


Fig. 1 — Geiger-Mueller Tube.

The polar regions are of particular interest to those who will be watching the radiation counter data channels. As the particles spew out from the sun, some of the particles which are electrically charged (electrons, protons and certain ions) are deflected in their straight-line paths by the presence of the Earth's magnetic field. As a result, many more of these particles cascade down in the region of the magnetic poles than at other latitudes. A well-known consequence of this disparity in flux in the ionosphere is the fact that the aurora borealis (Northern Hemisphere) and the aurora australis (Southern Hemisphere) occur in latitudes of 70 to 80 degrees (geomagnetic). The aurora is a luminous emission chiefly in the E-layer caused by the ionization of the thin air by particles and radiation. Thus, one can obtain insight to the existence of aurora even before it is visible at either optical or radio wavelengths by monitoring the UoSAT telemetry.

Finally, by watching for correlations between the radiation counters and the magnetometer, insight into the complex interrelations of the ionosphere and the magnetosphere may be afforded. It all sounds very enticing. And the notable factor with which we close this tech brief is that with your personal computer and an elementary interface adapter connected to your 2-meter rig, you too can sit in the comfort of your shack and know what is happening in the auroral oval at that instant. Boggles the mind!

Fig. 2 — Geiger tube timing.



Rotary International Sponsors Cells

Rotary International is a service organization dedicated to the promotion of world understanding and peace. In these objectives it closely parallels some of the objectives of amateur radio. In an exemplary case illustrating the positive accomplishment possible with the enthusiasm of key individuals, AMSAT fund raising efforts were bolstered by more than $1000 recently.

Mr. H.B. Packsoy, KQ5S, LM-1154, of Dallas is Chairman of the World Community Service Committee of the Park Cities Rotary Club near Dallas. Since late spring he has been working with various officials of Rotary to make known to them the potential for public service of the Radio Amateur Space Program in general and AMSAT's Phase III satellites in particular. The work of KQ5S through Rotary has resulted in a recent donation of $1035 to AMSAT. Now KQ5S wants to take the appeal through Rotary to an international audience for support.

AMSAT is deeply indebted to Rotary International for its sponsoring of AMSAT's satellite projects. AMSAT gratefully acknowledges the sincere efforts and outstanding results of Mr. Packsoy's tireless campaign on its behalf. Keep up the good work!

Surrey Announces Designation

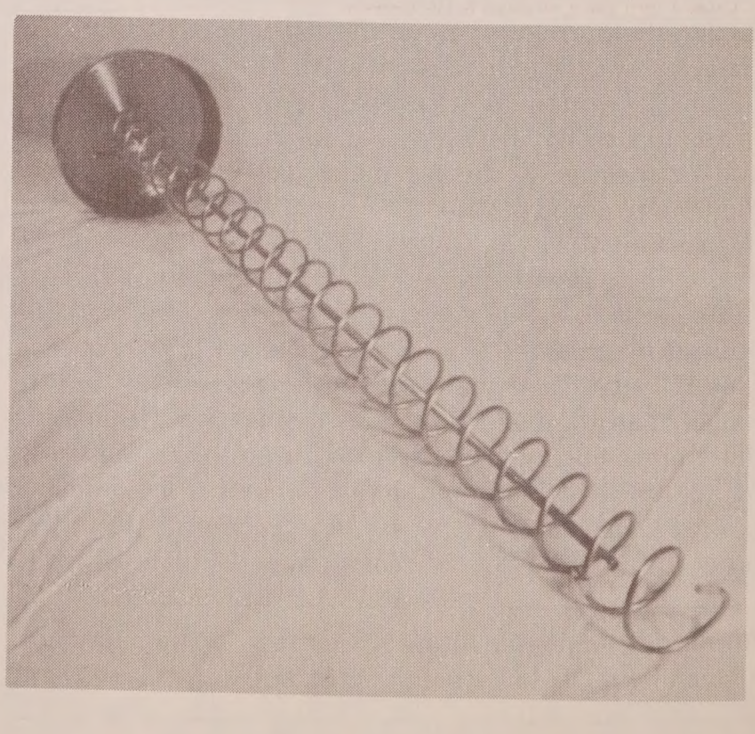
UoSAT Project Manager Dr. Martin Sweeting, G3YJO, has informed AMSAT that after successfully attaining orbit, UoSAT will thereafter be called UoSAT-OSCAR 9 or UO-9. A long held tradition among builders and operators of satellites is that the final name not be used to refer to a spacecraft until it's in orbit. Thus, Phase IIIA never came to be called AMSAT-OSCAR 9 as a consequence of its early demise. AMSAT-OSCAR 8 was known as AO-E prior to attaining orbit.

By employing the appellation UoSAT-OSCAR 9, the University of Surrey continues the OSCAR tradition begun 20 years ago with the launch of OSCAR 1.

The Tucson Fry Pan Special

Those contemplating antennas for the L-transponder on Phase IIIB will want to check this one out. Using a 10" (25 cm) aluminum skillet as a reflector, the newest creation of Bill Allen, W7US, is a wonder indeed. Overall length is 43" (20 turns) and the diameter is a little over 3". Bill got the idea while in Bavaria last year for Oktoberfest. It seems the brewmeister in the town had a seven thousand liter keg from which he could not remove the "cork." A ham from Munich just happened by with his helix and the rest is history. More on the design in a future *ORBIT Magazine*.

The W7US Fry Pan Special has 20 turns of tubing and is 43 inches long. This item may be just the ticket for upcoming Phase III L-band transponder operation. Complete details of the design will appear in a future issue of *ORBIT Magazine*.



ASR Spotlight On: UoSAT (Continued from ASR #16)

Telecommand System: (Dr. Martin Sweeing G3YJO, UOS-AMSAT, UK)

Two modes of control over the spacecraft are available, with a repertoir of 66 latched, two-state commands:

1) Direct, real-time control of the spacecraft's functions by Ground Command Stations using one of two redundant VHF/UHF command receivers.

2) Indirect, stored-program control executed by one of the two on-board microcomputers according to a 'diary' loaded in advance from a Ground Command Station via the telecommand uplink.

Any valid command data emanating from the Ground Stations have an over-riding precedence with any command data simultaneously issued by the on-board microcomputers. The primary computer (RCA1802) has precedence over the secondary computer (F100L), unless otherwise instructed from the ground.

The Telecommand uplinks also carry high speed data to enable program software and data to be loaded into the on-board microcomputers.

Antenna Systems: (Tony Brown, UOS-AMSAT, Dr. Mike Underhill, P.R.L., UK)

7-14-21-28 MHz Beacons Expt.—Centre-fed, 'V' dipole of 2.5 metres each arm. Fed via a narrow-band matching network. Linear polarisation.

145 MHz General Data Beacon—/4 canted turnstile fed via /4 semi-rigid coaxial hybrid, l.h.c.p., +3 dBi gain.

435 MHz Engineering Data Beacon—same antenna system and hybrid feed as above operating on harmonic overtone. l.h.c.p., +5 dBi gain.

2.4 GHz Beacon Expt.—3.5 turn helix, l.h.c.p., +6.5 dBi gain.

10.47 GHz Beacon Expt.—4 turn slot helix, l.h.c.p., +8 dBi gain.

All polarisations are given according to the IEEE definition. The circularity of the polarisation will tend towards elliptical at low elevation angles.

Navigation Magnetometer: (Dr. Mario Acunia, AMSAT-USA, Christine Sweeting, G6APF, UOS-AMSAT, UK)

A three-axis, flux-gate magnetometer mounted on the upper (+z, +x) facet of the s/c wing will provide information on the orientation of the s/c in orbit by the comparison of measured earth magnetic field vectors with existing models. It is anticipated that the navigation magnetometer will be able to determine the orientation of the s/c to within 2 degrees. Solar cells mounted on the top and bottom (+z & −z) facets of the s/c resolve the up/down ambiguity. The data from the magnetometer are available in real time through the telemetry system.

Experminetal Modules: Spacecraft Microcomputers: (Tony Jeans, G8ONO, Chris Haynes, UOS-AMSAT, UK) ***High Level Software:*** (Dr. Karl Meinzer, AMSAT-DL, Robin Gape, Chris Trayner, AMSAT-UK)

There are two powerful on-board microcomputers which have access to the s/c experiments telemetry and command systems, enabling:

Telemetry surveillance and command & status management.

Experiment data storage & processing.

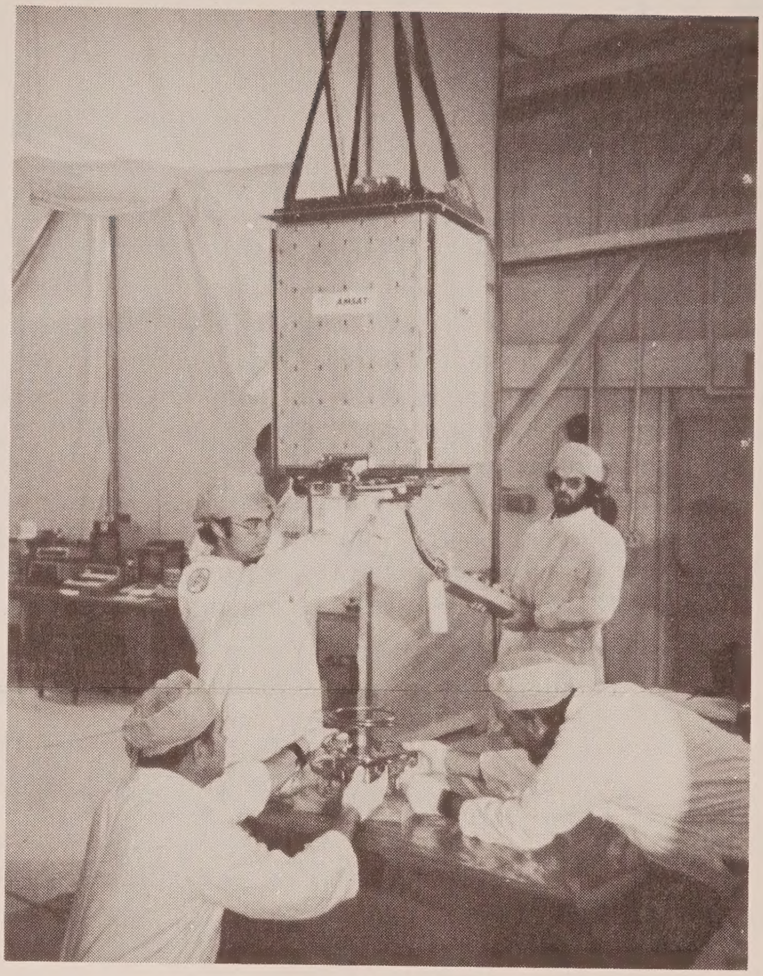
Dissemination of orbital data, operating schedules & spacecraft 'news'.

Closed-loop attitude control employing the magnetorquers.

The primary s/c computer is based around the RCA 1802 microprocessor and supports 8 parallel ports, 2 serial ports and 16k bytes of d.r.a.m. memory with access to a further 32k bytes of d.r.a.m. memory in the Video Display Experiment. The paralell ports interface directly to the Telemetry & Command systems and to the Radiation, Magnetometer and Speech Synthesiser experiments allowing high speed sampling of data. The two serial ports provide redundant data paths and can also generate a wide range of data formats & rates available to the Data Beacons. It is anticipated that this computer will support the multi-tasking software system - IPS - developed by Karl Meinzer and will provide a useful opportunity to evaluate IPS before the launch of the AMSAT Phase III communications satellites.

The secondary s/c computer is based around the Ferranti F100L microprocessor and is configured as a minimum system with serial interfaces to the s/c telemetry, and command systems. This does however allow the computer less direct but complete access to the s/c systems. The computer has 2 serial input/output ports and is supported with 32k bytes of cmos static r.a.m.. The F100L computer is a 16 bit machine.

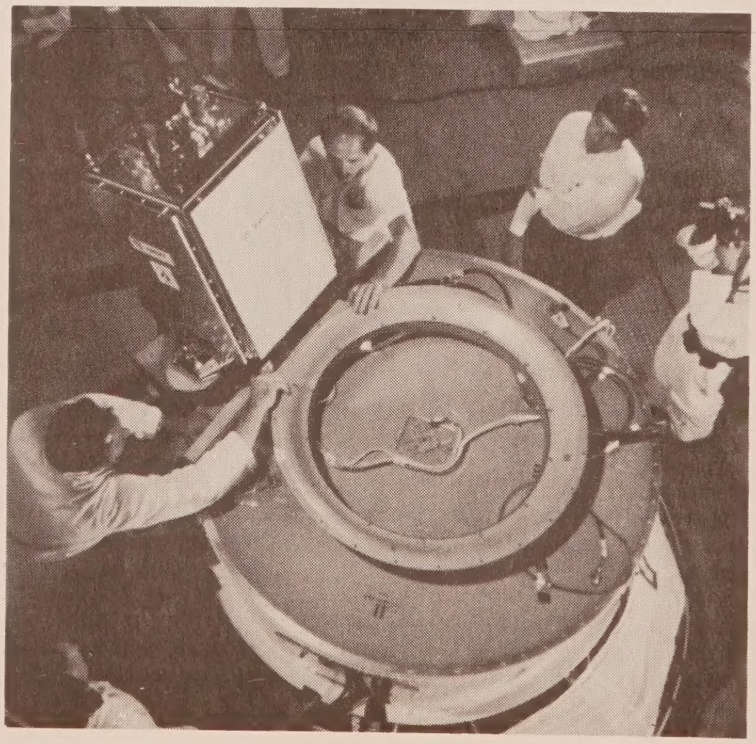
The software and accompanying data for both computers are loaded from the ground via the Telecommand link and can be modified or replaced during flight by a Ground Command Station in order to accomodate changes in the mission profile and to allow for the rectification of possible in-flight software or hardward failures.



Attitude Stabilisation & Control:

Two magnetorquer coils mounted on the +y, −y axes of the s/c will provide control over the attitude of the s/c by interaction with the earth's magnetic field, whilst after initial manoeuvres using the magnetorquers, a 50 foot boom with a 2.5 kg tip mass will be deployed to provide passive stabilisation resulting from gravity gradient forces. The magnetorquer will then be used intermittantly to dampen nutation & libration. The magnetorquer produces a field of approx. 50 amp turns per m*2 (50,000 pole.cms), allowing a maximum acceleration of the s/c of 1 degree/sec/100sec. The gravity gradient stabilisation should maintain the −z facet (bottom) of the s/c pointing towards the centre of the earth—important for the Camera Expt! The s/c will spin around the z-axis at a very slow rate—around 0.01 rpm.

UoSAT is attached to the top of the second stage of the Delta Rocket. The large ring is for mounting SME.



Quiz Nets Winner

Almost before the question was posed, the correct answer was forthcoming. In *ASR* #15, page 4, appeared a photo of W3GEY kneeling before a jug suspended in space. We asked what W3GEY was doing. In *ASR* #16, we suggested that the first correct answer would garner the originator a new Hams-In-Space Sweatshirt.

The first correct answer came from Buck Ruperto, W3KH, AMSAT's Western Pennsylvania Area Coordinator. For his correct answer Buck gets a sweatshirt. (Let us know your size, Buck.) Also submitting a correct answer was Birger Lindholm of Dalsbruk, Finland. Birger will also be awarded a sweatshirt since the mail delays to/from Finland probably accounted for the small difference in arrival time of his reply compared to W3KH's. Also submitting the correct answer at press time was Kaz Deskur, K2ZRO. All three pointed out that the correct answer was to be learned from the photo on page 2 of that *ASR* and the article which accompanied it. Congratulations to our sharp-eyed, keen-witted readers! For those of you who didn't guess correctly, your turn will come soon. The correct answer may be deduced by a close inspection of the photo on page 2 of *ASR* #15. There you will see a pulley and line arrangement rigged to assist in the deployment of the gravity gradient stabilizer boom which extends from the top of the spacecraft. The water in the jug was measured to provide a proper counterweight.

Autumn Coverings Cite Space Theme

With the approach of Autumn in the Northern Hemisphere, the air is cooling and we all must dig into our closets for the warmer clothes. Just in time for Autumn, AMSAT announces that the AMSAT Hams-In-Space Sweatshirts are ready to go. These heavyweight, durable, long-sleeve sweatshirts are just what you need for that Autumn hamfest, raking the leaves or jogging through the park. A $15 donation to AMSAT will result in your obtaining a premium AMSAT Hams-In-Space Sweatshirt. Send to AMSAT, P.O. Box 27, Washington, DC 20044. Be sure to specify size. The sweatshirts as well as the new sew-on patches, QSL samples and other AMSAT personal "goodies" will be on display at the annual meeting October 17th at Goddard. Be there.

Seattle Op Claims Unique W.A.S.

In *ASR* #16 we reported a number of recent, significant accomplishments on AMSAT-OSCAR 8J. Now comes further word from W7UFE that he believes that if his claim for W.A.S. J is accepted, he will be the ONLY one to have ever worked all 50 on all three satellite modes, that is, Modes A, B and J. Who will be first to do it with the L-transponder on Phase IIIB?

Thinking about antennas for the Mode 'X', L-transponder? W7US has some ideas for you. See photo elsewhere in this *ASR*.

Shuttle Mishap is Bad/Good News

Depending on what project you were most interested in, the week of 21 Sept. 81 was either a bad one or a good one for reaching full launch readiness. On Tuesday, 22 Sept., an incident at Cape Canaveral appears to have dealt the second flight of NASA's Space Transportation System (STS), or simply the "Shuttle", a costly delay. While loading the toxic oxidizer Nitrogen Tetroxide (N_2O_4) through a conduit just behind the orbiter's nose near the cockpit of the Shuttle *Columbia*, a leak developed in one of the seals in a quick disconnect normally connected to a fill valve, dumping one to three gallons of the fluid down the side of the spacecraft. The *Columbia* was in the vertical position on the launch gantry at the time. Consequently, the N_2O_4 splashed down the entire length of the spacecraft damaging hundreds of the critical silica tiles wherever it contacted them. The tiles cover much of the exterior, lower surfaces to protect *Columbia* from the incandescent heat of reentry at Mach 25. According to Launch Operations Director, Dr. George Page, the repairs would take "at least two weeks but the answer is very 'iffy' since we don't have very much information on the extent of damages at this time."

In terms of AMSAT plans, the slip of the Shuttle launch to beyond October 23 from the formerly scheduled date of 9 Oct. was good news. As reported in *ASR* #16, SME/UoSAT could have slipped to 6 Oct. without any conflict with Shuttle. But if SME/UoSAT had slipped beyond the 6th, it could be launched no earlier than the 15th. The SME Project Office was very unhappy with the prospect of a launch as late as the 15th since much of the relevancy of the SME experiment depends on its launch around the time of Solar Max(imum). Thus, with the slip of Shuttle to no earlier than the 23rd of October, there is the likelihood that SME/UoSAT could be slipped beyond the 6th without the necessity of slipping to the rear of the Shuttle. This circumstance may prove critical since, as reported in *ASR* #16, the retrofit and check-out of the software needed to resolve the "space-junk" issue may take a bit longer than expected.

So it's one of those situations where the misfortune of the STS folks is the good fortune of SME/UoSAT. Still a question mark, however, is the Satellite Business Systems (SBS) launch which is supposed to be launched before SME/UoSAT. SBS is about ready to go, but, as we've seen with the Shuttle/SME/UoSAT relationship, the timing and interweaving of the launches leaves many an interested party shaking his head in bewilderment at the curious network of interrelations that exist between seemingly disparate enterprises.

Editors Note: At press time UoSAT was due to be launched 5 Oct. 81 at about 1130 UTC.

AMSAT Satellite Report *is published and mailed First Class bi-weekly by The Radio Amateur Satellite Corporation, P.O. Box 27, Washington, DC 20044 for the purpose of enhancing communications about the Amateur Radio Satellite Program. Subscription rate is $18.00 ($26.00 overseas) yearly by check or money order to "Satellite Report," 221 Long Swamp Road, Wolcott, CT 06716. Information published herein may be quoted without permission provided credit is given.*